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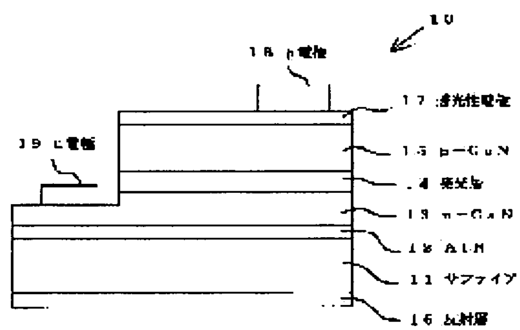
(54) III NITRIDE BASED COMPOUND SEMICONDUCTOR LIGHT EMITTING ELEMENT

(57)Abstract:
PROBLEM TO BE SOLVED: To enhance fabrication efficiency and light output efficiency of a III nitride compound semiconductor light emitting element by providing a reflective layer of Rh having a specified thickness on the side opposite to the side where a semiconductor layer is formed.
SOLUTION: An n electrode 19 comprises two layers of Al and V and after a p-type layer 15 is formed, the p-type layer 15, a light emitting layer 14 and an n-type layer 13 are removed partially by etching. Subsequently, a transmissive electrode 17 is formed of thin gold film on the n-type layer 13 by deposition while covering the upper surface of a p-type layer 18 substantially entirely. The p-type layer 18 also comprises a material containing gold and after it is formed on the transmissive electrode 17 by deposition and each chip is separated, a reflective layer 16 is bonded to a metal lead frame through silver paste and the p-electrode 18 and n-electrode 19 are connected with the lead frame through a wire. Since the reflective layer is formed of Rh and the thickness is set in the range of 50-2000 Å, a high quality light emitting element can be fabricated.



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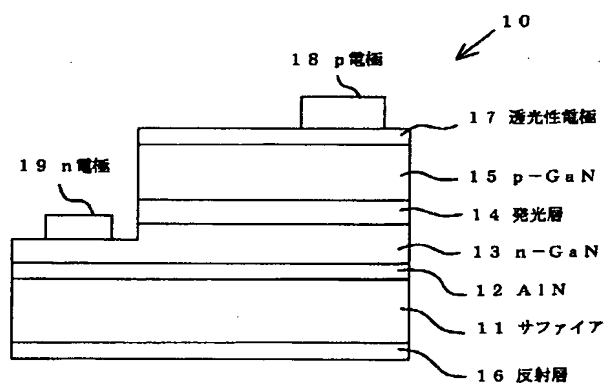
(54)【発明の名称】　ＩＩＩ族窒化物系化合物半導体発光素子

(57)【要約】
【目的】　製造効率が高く、かつ光の取り出し効率も高いIII族窒化物系化合物半導体発光素子を提供する。
【構成】　基板のIII族窒化物系化合物半導体層が積層された面の反対の面に５０Å～２０００Åの厚さのＲｈからなる反射層を設ける。



【特許請求の範囲】
【請求項１】　基板と、
前記基板上に形成される半導体層と、
前記基板の前記半導体層が形成される面と反対の面に５０Å～２０００Åの厚さのＲｈからなる反射層を備えてなるIII族窒化物系化合物半導体発光素子。
【請求項２】　前記反射層の厚さが１００Å～１５００Åである、ことを特徴とする請求項１に記載のIII族窒化物系化合物半導体発光素子。
【請求項３】　前記反射層の厚さが１５０Å～１０００Åである、ことを特徴とする請求項１に記載のIII族窒化物系化合物半導体発光素子。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】本発明はIII族窒化物系化合物半導体発光素子に関する。詳しくは、基板の半導体層が形成される面と反対の面に反射層を備えるIII族窒化物系化合物半導体発光素子に関する。
【０００２】
【従来の技術】サファイア等の絶縁性基板上にIII族窒化物系化合物半導体層を備え、基板の半導体層が形成される面と反対の面に金属反射層を形成した構成の発光素子が特開平６－６９５４６号公報に開示されている。金属反射層は、半導体層中に形成された発光層において発光して基板を通して出てくる光を反射して電極側から取り出すことを可能とし、発光素子の光の取り出し効率を高めるために設けられるものである。上記公報では、金属反射層の材料としてＡｌ、Ｉｎ、Ｃｕ、Ａｇ、Ｐｔ、Ｉｒ、Ｐｄ、Ｒｈ、Ｗ、Ｍｏ、Ｔｉ、Ｎｉ等の金属の単体あるいはそれらの合金が挙げられている（同公報【００１３】参照。）。
【０００３】
【発明が解決しようとする課題】本発明者らは、基板の半導体層が形成される面と反対の面に形成される金属反射層について検討したところ以下の課題を見出した。上記公報記載の実施例では、反射層としてＡｌからなる３０００Åの厚さの層を形成し、エッチング工程等を経た後、ダイシングソーにより０．５ｍｍ×０．５ｍｍ（実施例１）又は１ｍｍ×１ｍｍ（実施例２）のチップに分離している。しかしながら、ダイシングソーを用いたチップの分離では、装置の性能上分離できるチップの大きさに限界がある。そこで、より微小なチップを歩留まりよく作製しようとすれば、例えば、反射層形成後反射層側からスクライバにより基板にケガキ線をいれ、該ケガキ線に沿って各チップを分離する方法が考えられる。しかし、上記実施例のように反射層をＡｌ等の比較的軟質（高粘度）かつ低融点の金属で形成すれば、反射層をスクライブする際に反射層の材料がスクライバの刃にからみつき目詰まりを起こしやすい。その結果、効率的にスクライブ工程を行えなくなる。このように、Ａｌ等の軟質かつ低融点の金属を反射層の材料として用いることは工業的にみて現実的でない。
【０００４】以上の知見を基に、本発明者らは好適な反射層の材料を見出すべく、いくつかの金属について、反射層としての適性を評価した。評価は、反射率、耐食性及びスクライブ性（チップの分離工程においてスクライブが支障なく行える性質）の基準により行った。尚、耐食性の評価は、酸素及び塩素に対する耐食性の総合評価により求めた。以下にその評価結果を示す。

金属	反射率	耐食性	スクライブ性
Ｃｒ	△	△～○	△
Ｔｉ	△	△～○	△
Ａｌ	○	△	×
Ａｇ	○	△	×
Ｒｈ	○	○	○

○：高い　　△：中程度　　×：低い

この結果より、Ｒｈが反射層として非常に適した金属であることがわかる。尚、製造効率の観点からすれば、反射層としての効果を維持できる限りにおいて反射層は薄くすることが望ましいと考えられる。
【０００５】本発明は上記検討の結果なされたものであり、製造効率が高く、かつ光の取り出し効率も高いIII族窒化物系化合物半導体発光素子を提供することを目的とする。
【０００６】
【課題を解決するための手段】本発明は上記目的を達成すべくなされたものであり、その構成は以下の通りである。基板と、前記基板上に形成される半導体層と、前記基板の前記半導体層が形成される面と反対の面に５０Å～２０００Åの厚さのＲｈからなる反射層を備えてなるIII族窒化物系化合物半導体発光素子。
【０００７】本発明の反射層の材料であるＲｈは可視光に対して反射率が高く、発光層で生じ基板を通過した光を主たる光の取り出し方向へ高率に反射できる。また、Ｒｈは硬質（粘性の低い）かつ高融点の金属なので、反射層をスクライブした際にスクライバの刃を目詰まりさせにくい。スクライブにより熱が生じた場合であっても、粘度の上昇によりスクライバの刃の目詰まりを起こしやすくなることもない。本発明の構成では反射層の厚さを５０Å～２０００Åとしており、かかる範囲の厚さを有する反射層によれば、基板を通過し反射層表面に到達した光の実質的に全部を反射でき、同時に、チップの分離工程における反射層のスクライブを効率的に行うことができる。このように、膜厚５０Å～２０００ÅのＲｈからなる反射層を基板の半導体層が形成される面と反対の面上に設ける構成をとることにより、光の取り出し効率の高いIII族窒化物系化合物半導体発光素子を提供できるとともに、チップの分離工程を効率的に行え、発光素子の製造効率の上昇が図られる。
【０００８】また、Ｒｈは酸素や塩素等に対して耐食性

があるので、製造工程及び使用状態において反射層の劣化が少ない。このように、反射層をＲｈで形成することにより、劣化が少なく、かつ品質の安定した反射層が得られ、即ち、高品質の発光素子を得ることができる。

【０００９】

【発明の実施の形態】本発明の半導体層はIII族窒化物系化合物半導体からなる。III族窒化物系化合物半導体は、一般式として$Al_X Ga_Y In_{1-X-Y}N$（$0 \leqq X \leqq 1$、$0 \leqq Y \leqq 1$、$0 \leqq X+Y \leqq 1$）で表され、ＡｌＮ、ＧａＮ及びＩｎＮのいわゆる2元系、$Al_x Ga_{1-x}N$、$Al_x In_{1-x}N$及び$Ga_x In_{1-x}N$（以上において$0 \leqq x \leqq 1$）のいわゆる３元系を包含する。III族元素の一部をボロン（Ｂ）、タリウム（Ｔｌ）等で置換しても良く、また、窒素（Ｎ）の一部もリン（Ｐ）、ヒ素（Ａｓ）、アンチモン（Ｓｂ）、ビスマス（Ｂｉ）等で置換できる。III族窒化物系化合物半導体は任意のドーパントを含むものであっても良い。発光素子の素子機能部分は上記２元系若しくは3元系のIII族窒化物系化合物半導体より構成することが好ましい。III族窒化物系化合物半導体は任意のドーパントを含むものであっても良い。ｎ型不純物として、Ｓｉ、Ｇｅ、Ｓｅ、Ｔｅ、Ｃ等を用いることができる。ｐ型不純物として、Ｍｇ、Ｚｎ、Ｂｅ、Ｃａ、Ｓｒ、Ｂａ等を用いることができる。なお、かかるｐ型不純物をドープしたのみではIII族窒化物系化合物半導体を低抵抗のｐ型半導体とすることは困難であり、ｐ型不純物をドープした後にIII族窒化物系化合物半導体を電子線照射、プラズマ照射若しくは炉による加熱にさらすことが好ましい。III族窒化物系化合物半導体は、有機金属気相成長法（ＭＯＣＶＤ法）のほか、周知の分子線結晶成長法（ＭＢＥ法）、ハライド系気相成長法（ＨＶＰＥ法）、液相成長法等によっても形成することができる。

【００１０】基板には透光性のサファイアまたはＺｎＯ等が用いられる。これらの材料は発光色に対して透明だからである。III族窒化物系化合物の半導体層を成長させる面は特に限定されない。基板のIII族窒化物系化合物半導体層が積層される面（以下、「基板表面」という。）と反対の面（以下、「基板裏面」という。）にはＲｈからなる反射層が形成される。反射層は半導体層の発光面で生じ基板方向に向かった光（以下、「反対方向の光」という。）を反射するために設けられる。

【００１１】Ｒｈは白金族元素の１つであり、その表面は銀白色である。そのため可視光線に対して反射率が高く、その表面で効率よく反対方向の光を反射することができる。また、Ｒｈは酸素、塩素等に対して安定な金属であるので、発光素子の製造工程における洗浄等により腐食されることがなく、長時間の使用による劣化も少ない。さらには、Ａｇに対しても非反応性であるので後述の銀ペーストとの直接接触により劣化することがない。加えて、Ｒｈは硬質な金属であるので、発光素子の分離、加工工程においてスクライブされた際にスクライバーの刃を詰まらせにくい。スクライブにより熱が生じた場合にあっても、Ｒｈの融点は１９７０℃と比較的高いので、スクライバーの刃を詰まらせやすくなるおそれもない。

【００１２】反射層の厚さは、５０Å～２０００Åとする。５０Å以上とするのは、発光面で生じた反対方向の光の実質的に全部を反射層で反射するためである。他方、２０００Å以下とするのは、後述のチップの分離工程において反射層の一部はスクライバにより除去されるため、必要以上に厚い反射層を設けることは分離、加工効率を低下させる要因となるからである。反射層の厚さは、好ましくは１００Å～１５００Åとする。更に好ましくは１５０Å～１０００Åとする。反射層の形成方法は特に限定されないが、プラズマＣＶＤ、熱ＣＶＤ、光ＣＶＤ等のＣＶＤ（Ｃｈｅｍｉｃａｌ　Ｖａｐｏｕｒ　Ｄｅｐｏｓｉｔｉｏｎ）、スパッタ、蒸着、ＥＣＲ法等の（Ｐｙｓｉｃａｌ　Ｖａｐｏｕｒ　Ｄｅｐｏｓｉｔｉｏｎ）等の方法を利用できる。

【００１３】

【実施例】以下、本発明を実施例により更に詳しく説明する。図１は本発明の一の実施例である発光素子１０の構成を示す図である。各層のスペックは次の通りである。

層		組成：ドーパント	（膜厚）
ｐ型層１５		ｐ－ＧａＮ：Ｍｇ	（0.3μm）
発光層１４		超格子構造	
	量子井戸層	$In_{0.15}Ga_{0.85}N$	（35Å）
	バリア層	ＧａＮ	（35Å）
	量子井戸とバリア層の繰り返し数：１～１０		
ｎ型層１３		ｎ－ＧａＮ：Ｓｉ	（4μm）
バッファ層１２		ＡｌＮ	（100Å）
基板１１		サファイア	（300μm）
反射層１６		Ｒｈ	（300Å）

【００１４】バッファ層１２は高品質の半導体層を成長させるために用いられ、周知のＭＯＣＶＤ法等により基板１１表面上に形成される。本実施例ではＡｌＮをバッファ層として用いたが、これに限定されるわけでなく、

ＧａＮ、ＩｎＮの二元系、一般的にAl_xGa_yN（$0≦x≦1$、$0≦y≦1$、$x+y=1$）で表されるIII族窒化物系化合物半導体（三元系）、さらには$Al_aGa_bIn_{1-a-b}N$（$0≦a≦1$、$0≦b≦1$、$a+b≦1$）で表されるIII族窒化物系化合物半導体（四元系）を用いることもできる。各半導体層は周知のＭＯＣＶＤ法により形成される。この成長法においては、アンモニアガスとIII族元素のアルキル化合物ガス、例えばトリメチルガリウム（ＴＭＧ）、トリメチルアルミニウム（ＴＭＡ）やトリメチルインジウム（ＴＭＩ）とを適当な温度に加熱された基板上に供給して熱分解反応させ、もって所望の結晶をバッファ層１２上に成長させる。勿論、各半導体層の形成方法はこれに限定されるものではなく、周知のＭＢＥ法によっても形成することができる。発光層の構造としては、発光層１４が超格子構造のものに限定されず、シングルヘテロ型、ダブルヘテロ型及びホモ接合型であってもよい。その他、ＭＩＳ接合、ＰＩＮ接合を用いて発光層を構成することもできる。

【００１５】発光層１４とｐ型層１５との間にマグネシウム等のアクセプタをドープしたバンドキャップの広い$Al_XGa_YIn_{1-X-Y}N$（$0≦X≦1$、$0≦Y≦1$、$X+Y≦1$）層を介在させることができる。これは発光層１４の中に注入された電子がｐ型層１５に拡散するのを防止するためである。ｐ型層１５を発光層１４側の低ホール濃度p^-層とｐ電極１８の高ホール濃度p^+側とからなる２層構造とすることができる。

【００１６】ｎ電極１９はＡｌとＶの２層で構成され、ｐ型層１５を形成した後、ｐ型層１５、発光層１４、及びｎ型層１３の一部をエッチングにより除去し、蒸着によりｎ型層１３上に形成される。透光性電極１７は金を含む薄膜であり、ｐ型層１８の上面の実質的な全面を覆って積層される。ｐ電極１８も金を含む材料で構成されており、蒸着により透光性電極１７の上に形成される。

【００１７】上記の工程により各半導体層及び各電極を形成した後、各チップの分離工程及び反射層１６の形成工程を行う。まず、各半導体層が積層された面の各チップの境界に深さ約１０μｍのラインをダイシングにより入れる。続いて、基板裏面を研磨することにより、基板１１をおよそ１／３の厚さにする。次に、研磨された基板裏面を有機洗浄した後、基板裏面上にＥＢ蒸着法によりＲｈを３００Å積層することにより反射層１６を形成する。その後、反射層１６側より各チップの境界をスクライブし、基板裏面の各チップの境界にケガキ線を入れる。最後に、ブレーキング工程を行い各チップを分離する。上記工程により３２０μｍ×３２０μｍのチップを得る。

【００１８】各チップに分離した後、反射層１６は金属製のリードフレーム３０に銀ペースト４０を介して固定され、ｐ電極１８及びｎ電極１９はワイヤ３２、３３によりリードフレーム３０及び３１にそれぞれ接続される。その後、封止レジン５０で封止されることにより発光装置ランプ（図２参照）とされる。発光ランプ２０の光度を測定したところ、反射層１６を設けない従来品に比較して約１．５倍の光度が得られた。

【００１９】

【試験例】次に、実施例の発光素子１０の時間経過による光度低下率を評価した。試験には発光素子１０を組み込んだ発光ランプ２０を用い、１００℃の温度条件の下、３０ｍＡの電流を連続的に供給した場合の各測定時間における発光ランプ２０の光度と初期光度との比を相対光度として求め、各測定時間の相対光度を比較することにより時間経過による光度低下率を評価した。比較例として、発光素子１０において反射層１６を設けず、その他の構成を発光ランプ２０と同一としたものを用いた。以下に試験結果を示す。

	初期値	100時間後	1000時間後
発光ランプ２０（Ｒｈ反射層）	１００	９５	９２
比較例（反射層なし）	１００	８０	６０

上記試験結果より、比較例では１０００時間の連続点灯により４０％程度光度が低下するが、Ｒｈからなる反射層を設けた発光装置２０では８％程度しか光度が低下しない。この結果より、Ｒｈからなる反射層を設けることにより長時間の使用による光度低下が大幅に抑制されることがわかる。

【００２０】以上のように、本発明の発光素子は、Ｒｈからなる所定の厚さの反射層を設けることにより光の取り出し効率が高く、また、製造効率も良いという利点を有する。さらに、反射層が耐食性の材料で形成されるので、長時間の使用による光度低下も非常に少ないという利点も有する。

【００２１】この発明は、上記発明の実施の形態及び実施例の説明に何ら限定されるものではない。特許請求の範囲の記載を逸脱せず、当業者が容易に想到できる範囲で種々の変形態様もこの発明に含まれる。

【００２２】以下、次の事項を開示する。

（１０）　基板と、前記基板上に形成される半導体層と、前記基板の半導体層が形成される面と反対の面に５０Å～２０００Åの厚さのＲｈからなる反射層を備えてなる積層体。

（１１）　前記反射層の厚さが１００Å～１５００Åである、ことを特徴とする（１０）に記載の積層体。

（１２）　前記反射層の厚さが１５０Å～１０００Åである、ことを特徴とする（１０）に記載の積層体。

（２０）　基板の一の面上にIII族窒化物系化合物半導体層を形成するステップと、前記基板の前記半導体層が形成されない他の一の面上にＲｈからなる反射層を５０

Å～２０００Å形成するステップと、を含んでなるIII族窒化物系化合物半導体発光素子の製造方法。

（２１）　前記反射層の厚さは１００Å～１５００Åである、ことを特徴とする（２０）に記載のIII族窒化物系化合物半導体発光素子の製造方法。

（２２）　前記反射層の厚さは１５０Å～１０００Åである、ことを特徴とする（２０）に記載のIII族窒化物系化合物半導体発光素子の製造方法。

（２３）　前記反射層側からスクライブすることにより前記基板を分離する、ことを特徴とする（２０）ないし（２２）に記載のIII族窒化物系化合物半導体発光素子の製造方法。

（３０）　基板の一の面にIII族窒化物系化合物半導体層を形成するステップと、前記基板の前記半導体層が形成されない他の一の面にＲｈからなる反射層を５０Å～２０００Å形成するステップと、を含んでなる製造工程により製造されるIII族窒化物系化合物半導体発光素子。

（３１）　基板の一の面にIII族窒化物系化合物半導体層を形成するステップと、前記基板の前記半導体層が形成されない他の一の面にＲｈからなる反射層を５０Å～２０００Å形成するステップと、前記反射層側からスクライブすることにより前記基板を分離するステップと、を含んでなる製造工程により製造されるIII族窒化物系化合物半導体発光素子。

（３２）　前記反射層を形成する厚さは１００Å～１５００Åである、ことを特徴とする（３０）又は（３１）に記載のIII族窒化物系化合物半導体発光素子

（３３）　前記反射層を形成する厚さは１５０Å～１０００Åである、ことを特徴とする（３０）又は（３１）に記載のIII族窒化物系化合物半導体発光素子の製造方法。

（４０）　基板と、前記基板上に形成される半導体層と、前記基板の半導体層が形成される面と反対の面に５０Å～２０００Åの厚さのＲｈからなる反射層を備えてなるIII族窒化物系化合物半導体発光素子が銀ペーストを介してリードフレームに固定される、ことを特徴とする発光装置。

（４１）　前記反射層の厚さが１００Å～１５００Åである、ことを特徴とする（４０）に記載の発光装置。

（４２）　前記反射層の厚さが１５０Å～１０００Åである、ことを特徴とする（４０）に記載の発光装置。

【図面の簡単な説明】

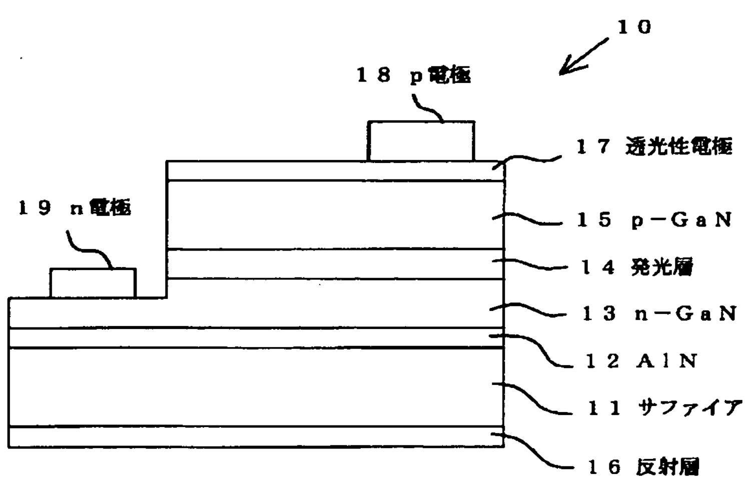
【図１】本発明の実施例である発光素子１０の構成を示す図である。

【図２】同じく発光素子１０を組み込んだ発光ランプ２０の構成を示す図である。

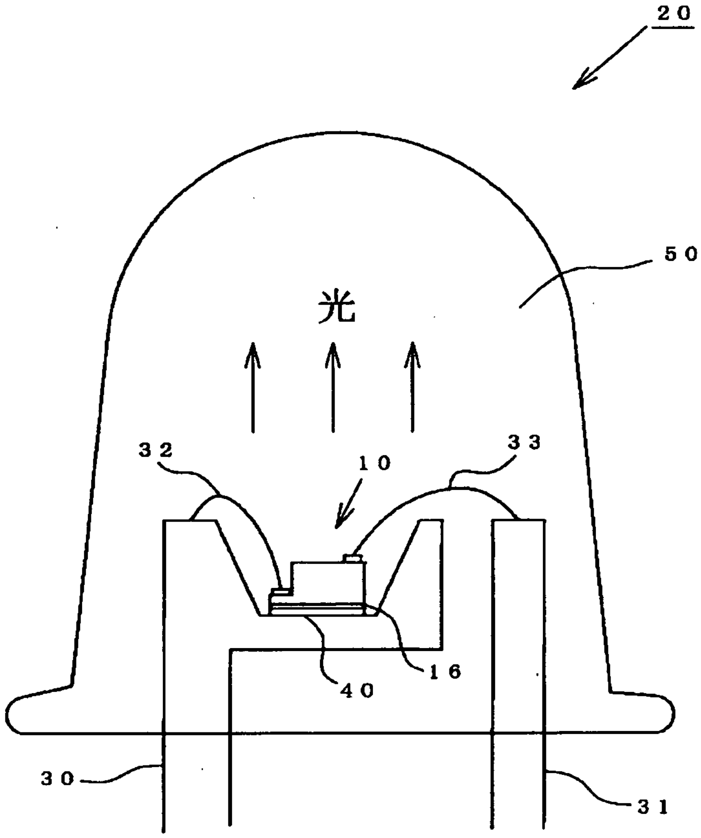
【符号の説明】

１０　発光素子
１１　サファイア基板
１２　バッファ層
１３　ｎ－ＧａＮ層
１４　発光層
１５　ｐ－ＧａＮ層
１６　反射層
２０　発光ランプ
４０　銀ペースト

【図１】



【図2】



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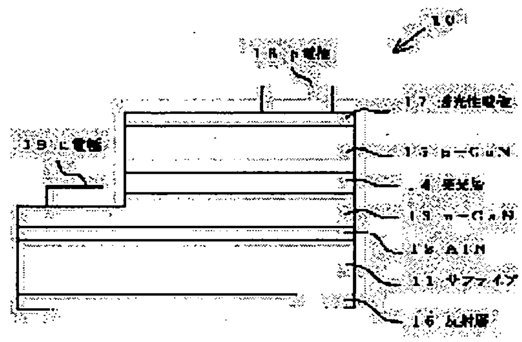
NAGASAKA NAOHISA

(54) III NITRIDE BASED COMPOUND SEMICONDUCTOR LIGHT EMITTING ELEMENT

(57)Abstract:

PROBLEM TO BE SOLVED: To enhance fabrication efficiency and light output efficiency of a III nitride compound semiconductor light emitting element by providing a reflective layer of Rh having a specified thickness on the side opposite to the side where a semiconductor layer is formed.

SOLUTION: An n electrode 19 comprises two layers of Al and V and after a p-type layer 15 is formed, the p-type layer 15, a light emitting layer 14 and an n-type layer 13 are removed partially by etching. Subsequently, a transmissive electrode 17 is formed of thin gold film on the n-type layer 13 by deposition while covering the upper surface of a p-type layer 18 substantially entirely. The p-type layer 18 also comprises a material containing gold and after it is formed on the transmissive electrode 17 by deposition and each chip is separated, a reflective layer 16 is bonded to a metal lead frame through silver paste and the p-electrode 18 and n-electrode 19 are connected with the lead frame through a wire. Since the reflective layer is formed of Rh and the thickness is set in the range of 50-2000 Å, a high quality light emitting element can be fabricated.



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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] The III group nitride system compound semiconductor light emitting device which comes to prepare the reflecting layer which consists of Rh with a thickness of 50A - 2000A for a field opposite to the field in which a substrate, the semi-conductor layer formed on said substrate, and said semi-conductor layer of said substrate are formed.
[Claim 2] The III group nitride system compound semiconductor light emitting device according to claim 1 characterized by what the thickness of said reflecting layer is 100A - 1500A.
[Claim 3] The III group nitride system compound semiconductor light emitting device according to claim 1 characterized by what the thickness of said reflecting layer is 150A - 1000A.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to an III group nitride system compound semiconductor light emitting device. It is related with the III group nitride system compound semiconductor light emitting device which equips with a reflecting layer a field opposite to the field in which the semi-conductor layer of a substrate is formed in detail.
[0002]
[Description of the Prior Art] It has an III group nitride system compound semiconductor layer on insulating substrates, such as sapphire, and the light emitting device of a configuration of having formed the metallic reflective layer in the field opposite to the field in which the semi-conductor layer of a substrate is formed is indicated by JP,6-69546,A. It is enabled for a metallic reflective layer to reflect the light which emits light in the luminous layer formed into the semi-conductor layer, and comes out through a substrate, and to take it out from an electrode side, and it is prepared in order to raise the ejection effectiveness of the light of a light emitting device. In the above-mentioned official report, metaled simple substances or those alloys, such as aluminum, In, Cu, Ag, Pt, Ir, Pd, Rh, W, Mo, Ti, and nickel, are mentioned as an ingredient of a metallic reflective layer (this official report [0013]). Reference. .
[0003]
[Problem(s) to be Solved by the Invention] When this invention persons examined the metallic reflective layer formed in a field opposite to the field in which the semi-conductor layer of a substrate is formed, they found out the following technical problems. In the example given [above-mentioned] in an official report, the dicing saw has separated into the chip (0.5mmx0.5mm (example 1) or 1mmx1mm (example 2)), after forming a layer with a thickness of 3000A it is thin from aluminum as a reflecting layer and passing through an etching process etc. However, in separation of the chip using a dicing saw, a limitation is in a chip size separable on the engine performance of equipment. Then, if it is going to produce a minuter chip with the sufficient yield, a scribing line is put into a substrate with a scriber from an after [reflecting layer formation] reflecting layer side, and how to separate each chip along with this scribing line can be considered, for example. However, if aluminum etc. forms a reflecting layer with the metal of elasticity (hyperviscosity) and a low-melt point point comparatively like the above-mentioned example, in case the scribe of the reflecting layer will be carried out, the ingredient of a reflecting layer is a lifting and a cone about blinding with slag to the cutting edge of a scriber. It becomes impossible consequently, to perform a scribe process efficiently. Thus, it sees industrially and is not realistic to use the metal of elasticity, such as aluminum, and a low-melt point point as an ingredient of a reflecting layer.
[0004] Based on the above knowledge, this invention persons evaluated the fitness as a reflecting layer about some metals so that they may find out the ingredient of a suitable reflecting layer. The criteria of a reflection factor, corrosion resistance, and scribe nature (property in which a scribe can be performed convenient in the separation process of a chip) performed evaluation. In addition, it asked for corrosion resistance evaluation by corrosion resistance comprehensive evaluation to oxygen and chlorine. The evaluation result is shown below.
A metal A reflection factor Corrosion resistance The scribe nature Cr ** **-O **Ti ** **-O **aluminum O ** xAg O ** xRh O O OO: Whenever [high middle / of **:] x: This low result shows that it is the metal for which Rh was very suitable as a reflecting layer. In addition, if it carries out from a viewpoint of manufacture effectiveness, as long as the effectiveness as a reflecting layer is maintainable, it will be thought that it is desirable to make it thin as for a reflecting layer.

[0005] This invention is made as a result of the above-mentioned examination, and manufacture effectiveness aims at offering a high III group nitride system compound semiconductor light emitting device also with the high ejection effectiveness of light.

[0006]

[Means for Solving the Problem] This invention is made that the above-mentioned purpose should be attained, and the configuration is as follows. The III group nitride system compound semiconductor light emitting device which comes to prepare the reflecting layer which consists of Rh with a thickness of 50A - 2000A for a field opposite to the field in which a substrate, the semi-conductor layer formed on said substrate, and said semi-conductor layer of said substrate are formed.

[0007] Rh which is the ingredient of the reflecting layer of this invention can reflect the light which the reflection factor was high, arose in the luminous layer to the light, and passed the substrate in the direction of ejection of a main light at high rate. Moreover, since Rh is a hard (viscosity is low) and high-melting metal, when the scribe of the reflecting layer is carried out, it is hard to carry out blinding of the cutting edge of a scriber. Even if it is the case where heat arises by the scribe, it does not lifting-come to be easy of the blinding of the cutting edge of a scriber with the rise of viscosity. With the configuration of this invention, thickness of a reflecting layer is made into 50A - 2000A, according to the reflecting layer which has the thickness of this range, all can be reflected substantially [the light which passed the substrate and arrived at the reflecting layer front face], and the scribe of the reflecting layer in the separation process of a chip can be efficiently performed to coincidence. Thus, while being able to offer an III group nitride system compound semiconductor light emitting device with the high ejection effectiveness of light by taking the configuration which prepares the reflecting layer which consists of Rh of 50A - 2000A of thickness on a field opposite to the field in which the semi-conductor layer of a substrate is formed, the separation process of a chip can be performed efficiently and the rise of the manufacture effectiveness of a light emitting device is achieved.

[0008] Moreover, since Rh has corrosion resistance to oxygen, chlorine, etc., there is little degradation of a reflecting layer in a production process and a busy condition. Thus, by forming a reflecting layer by Rh, there is little degradation, and the reflecting layer by which quality was stabilized is obtained, namely, the light emitting device of high quality can be obtained.

[0009]

[Embodiment of the Invention] The semi-conductor layer of this invention consists of an III group nitride system compound semiconductor. An III group nitride system compound semiconductor is expressed with AlXGaYIn1-X-YN (0<=X<=1, 0<=Y<=1, 0 <=X+Y<=1) as a general formula, and includes the so-called 3 yuan system of the so-called 2 yuan system of AlN, GaN, and InN, AlxGa1-xN, AlxIn1-xN, and GaxIn1-xN (it sets above and is 0<=x<=1). Boron (B), a thallium (Tl), etc. may permute some III group elements, and Lynn (P), an arsenic (As), antimony (Sb), a bismuth (Bi), etc. can permute some nitrogen (N). An III group nitride system compound semiconductor may contain the dopant of arbitration. As for the component functional division of a light emitting device, it is desirable to constitute from an above-mentioned 2 yuan system or an III group nitride system compound semiconductor of a 3 yuan system. An III group nitride system compound semiconductor may contain the dopant of arbitration. Si, germanium, Se, Te, C, etc. can be used as an n mold impurity. As a p mold impurity, Mg, Zn, Be, calcium, Sr, Ba, etc. can be used. In addition, it is difficult to dope this p mold impurity and to use an III group nitride system compound semiconductor as the p type semiconductor of low resistance in a request, and after doping p mold impurity, it is desirable to expose an III group nitride system compound semiconductor to electron beam irradiation, a plasma exposure, or heating at a furnace. An III group nitride system compound semiconductor can be formed with the molecular-beam crystal growth method (MBE law) of common knowledge besides metal-organic chemical vapor deposition (MOCVD law), halide system vapor growth (HVPE law), a liquid phase grown method, etc.

[0010] The sapphire of translucency or ZnO is used for a substrate. It is because these ingredients are transparent to the luminescent color. Especially the field into which the semi-conductor layer of an III group nitride system compound is grown up is not limited. The reflecting layer which consists of Rh is formed in the field (henceforth a "substrate rear face") where the III group nitride system compound semiconductor layer of a substrate is opposite to the field (henceforth a "substrate front face") by which a laminating is carried out. Since the light (henceforth "light of an opposite direction") which arose in respect of luminescence of a semi-conductor layer, and went in the direction of a substrate is reflected, a reflecting layer is prepared.

[0011] Rh is one of the platinum group metals, and the front face is silver white. Therefore, to a visible ray, a reflection factor can be high and the light of an opposite direction can be efficiently reflected on

the front face. Moreover, to oxygen, chlorine, etc., since it is a stable metal, it is not corroded by washing in the production process of a light emitting device etc., and Rh also has little degradation by use of long duration. Furthermore, to Ag, since it is nonresponsiveness, it does not deteriorate by direct contact to the below-mentioned silver paste. In addition, since Rh is a hard metal, when a scribe is carried out in separation of a light emitting device, and a processing process, it is hard to block the cutting edge of a scriber. When heat arises by the scribe, even if it is, the melting point of Rh does not have a possibility of becoming it being easy to block the cutting edge of a scriber with 1970 degrees C since it is comparatively high, either.
[0012] Thickness of a reflecting layer is made into 50A - 2000A. It may be 50A or more for reflecting all by the reflecting layer substantially [the light of the opposite direction produced in respect of luminescence]. On the other hand, it is because it becomes the factor which reduces separation and processing effectiveness that considering as 2000A or less prepares a reflecting layer thick beyond the need since a part of reflecting layer is removed by the scriber in the separation process of the below-mentioned chip. Thickness of a reflecting layer is preferably made into 100A - 1500A. Furthermore, it may be 150A - 1000A preferably. although especially the formation approach of a reflecting layer is not limited -- CVD(s) (Chemical Vapour Deposition), such as plasma CVD, Heat CVD, and Light CVD, a spatter, vacuum evaporationo, the ECR method, etc. -- etc. (Pysical Vapour Deposition) etc. -- an approach can be used.
[0013]
[Example] Hereafter, an example explains this invention in more detail. Drawing 1 is drawing showing the configuration of the light emitting device 10 which is the example of 1 of this invention. The spec. of each class is as follows.
Layer : Presentation: Dopant (thickness)
p type layer 15 : p-GaN:Mg (0.3 micrometers)
Luminous layer 14 : Superstructure Quantum well layer : In0.15Ga0.85N (35A)
Barrier layer : GaN (35A)
The number of repeats of a quantum well and a barrier layer: 1-10n type layer 13 : n-GaN:Si (4 micrometers)
Buffer layer 12 : AlN (100A)
Substrate 11 : Sapphire (300 micrometers)
Reflecting layer 16 : Rh (300A)
[0014] a buffer layer 12 is used in order to grow up the semi-conductor layer of high quality -- having -- well-known MOCVD -- it is formed on substrate 11 front face of law etc. Although AlN was used as a buffer layer in this example it is limited to this -- ******** -- the duality of GaNInN -- a system and the III group nitride system compound semiconductor (ternary system) generally expressed with AlxGayN (0<=x<=1, 0<=y<=1, x+y=1) -- The III group nitride system compound semiconductor (4 yuan system) furthermore expressed with AlaGabIn1-a-bN (0<=a<=1, 0<=b<=1, a+b<=1) can also be used. each semi-conductor layer -- well-known MOCVD -- it is formed of law. In this grown method, ammonia gas and the alkyl compound gas of an III group element, for example, trimethylgallium, (TMG), trimethylaluminum (TMA), and trimethylindium (TMI) are supplied on the substrate heated by suitable temperature, a pyrolysis reaction is carried out, it has, and a desired crystal is grown up on a buffer layer 12. of course, the thing by which the formation approach of each semi-conductor layer is limited to this -- it is not -- well-known MBE -- it can form also by law. As structure of a luminous layer, a luminous layer 14 may not be limited to the thing of a superstructure, but may be a terrorism mold and a gay assembling die in a terrorism mold and double to a single. In addition, a luminous layer can also be constituted using MIS junction and PIN junction.
[0015] The large AlXGaYIn1-X-YN (0<=X<=1, 0<=Y<=1, X+Y<=1) layer of the band cap which doped acceptors, such as magnesium, can be made to intervene between a luminous layer 14 and p type layer 15. This is for preventing that the electron poured in into the luminous layer 14 is spread in p type layer 15. p type layer 15 can be made into the two-layer structure which consists of a low hole concentration p-layer by the side of a luminous layer 14, and a high hole concentration p+ side of the p electrode 18.
[0016] After the n electrode 19 consists of two-layer [of aluminum and V] and forms p type layer 15, it removes a part of p type layer 15, luminous layer 14, and n type layer 13 by etching, and is formed on n type layer 13 of vacuum evaporationo. The translucency electrode 17 is a thin film containing gold, it covers the substantial whole surface of the top face of p type layer 18, and a laminating is carried out. The p electrode 18 also consists of ingredients containing gold, and it is formed on the translucency electrode 17 of vacuum evaporationo.

[0017] After forming each semi-conductor layer and each electrode according to the above-mentioned process, the separation process of each chip and the formation process of a reflecting layer 16 are performed. First, Rhine with a depth of about 10 micrometers is put into the boundary of each chip of the field where the laminating of each semi-conductor layer was carried out by dicing. Then, a substrate 11 is made into the thickness of 3 about 1/by grinding a substrate rear face. Next, after carrying out organic washing of the ground substrate rear face, a reflecting layer 16 is formed on a substrate rear face by carrying out 300A laminating of the Rh with EB vacuum deposition. Then, from a reflecting layer 16 side, the scribe of the boundary of each chip is carried out, and a scribing line is put into the boundary of each chip on the rear face of a substrate. Finally, a braking process is performed and each chip is separated. A 320micrometerx320micrometer chip is obtained according to the above-mentioned process.
[0018] After separating into each chip, a reflecting layer 16 is fixed to the metal leadframe 30 through the silver paste 40, and the p electrode 18 and the n electrode 19 are connected to leadframes 30 and 31 by wires 32 and 33, respectively. Then, it considers as a luminescence equipment lamp (refer to drawing 2) by carrying out the closure by closure resin 50. When the luminous intensity of the luminescence lamp 20 was measured, as compared with elegance, one about 1.5 times the luminous intensity of this was obtained conventionally which does not form a reflecting layer 16.
[0019]
[Test Example(s)] Next, the luminous-intensity decreasing rate by time amount progress of the light emitting device 10 of an example was evaluated. It asked for the ratio of the luminous intensity of the luminescence lamp 20 and initial luminous intensity in each measuring time at the time of supplying a 30mA current continuously as relative luminous intensity under 100-degree C temperature conditions using the luminescence lamp 20 which included the light emitting device 10 in the trial, and the luminous-intensity decreasing rate by time amount progress was evaluated by measuring the relative luminous intensity of each measuring time. As an example of a comparison, a reflecting layer 16 was not formed in the light emitting device 10, but what made other configurations the same as that of the luminescence lamp 20 was used. A test result is shown below.
Initial value 100 hours after 1000-hour late-coming light lamp 20 (Rh reflecting layer) 100 95 Example of 92 comparisons (with no reflecting layer) 100 80 From the 60 above-mentioned test result, although luminous intensity falls about 40% by continuation lighting of 1000 hours in the example of a comparison, luminous intensity falls only about 8% with the luminescence equipment 20 which prepared the reflecting layer which consists of Rh. From this result, by preparing the reflecting layer which consists of Rh shows that the luminous-intensity fall by use of long duration is controlled sharply.
[0020] As mentioned above, the light emitting device of this invention has the advantage that manufacture effectiveness is good, highly [the ejection effectiveness of light] by preparing the reflecting layer of the predetermined thickness it is thin from Rh. Furthermore, since a reflecting layer is formed with a corrosion resistance ingredient, it has the luminous-intensity fall by prolonged use, and the advantage of being very few.
[0021] This invention is not limited to explanation of the gestalt of implementation of the above-mentioned invention, and an example at all. It does not deviate from the publication of a claim but deformation modes various in the range this contractor can hit on an idea of easily are also contained in this invention.
[0022] Hereafter, the following matter is indicated.
(10) The layered product which comes to prepare the reflecting layer which consists of Rh with a thickness of 50A - 2000A for a field opposite to the field in which a substrate, the semi-conductor layer formed on said substrate, and the semi-conductor layer of said substrate are formed.
(11) A layered product given in (10) characterized by what the thickness of said reflecting layer is 100A - 1500A.
(12) A layered product given in (10) characterized by what the thickness of said reflecting layer is 150A - 1000A.
(20) The manufacture approach of the III group nitride system compound semiconductor light emitting device which comes to contain the step which forms 50A - 2000A of reflecting layers which consist of Rh on the field of other 1 in which the step which forms an III group nitride system compound semiconductor layer on the field of 1 of a substrate, and said semi-conductor layer of said substrate are not formed.
(21) The thickness of said reflecting layer is the manufacture approach of an III group nitride system compound semiconductor light emitting device given in (20) characterized by what is been 100A -

1500A.
(22) The thickness of said reflecting layer is the manufacture approach of an III group nitride system compound semiconductor light emitting device given in (20) characterized by what is been 150A – 1000A.
(23) (20) characterized by what said substrate is separated for by carrying out a scribe from said reflecting layer side thru/or the manufacture approach of an III group nitride system compound semiconductor light emitting device given in (22).
(30) The III group nitride system compound semiconductor light emitting device manufactured by the production process which comes to contain the step which forms 50A – 2000A of reflecting layers which consist of Rh in other fields of 1 in which the step which forms an III group nitride system compound semiconductor layer in the field of 1 of a substrate, and said semi-conductor layer of said substrate are not formed.
(31) The III group nitride system compound semiconductor light emitting device manufactured by the production process which comes to contain the step which forms 50A – 2000A of reflecting layers which consist of Rh in other fields of 1 in which the step which forms an III group nitride system compound semiconductor layer in the field of 1 of a substrate, and said semi-conductor layer of said substrate are not formed, and the step which separates said substrate by carrying out a scribe from said reflecting layer side.
(32) The thickness which forms said reflecting layer is an III group nitride system compound semiconductor light emitting device given in (30) characterized by what is been 100A – 1500A, or (31)
(33). The thickness which forms said reflecting layer is the manufacture approach of an III group nitride system compound semiconductor light emitting device given in (30) characterized by what is been 150A – 1000A, or (31).
(40) Luminescence equipment characterized by what the III group nitride system compound semiconductor light emitting device which comes to prepare the reflecting layer which consists of Rh with a thickness of 50A – 2000A for a field opposite to the field in which a substrate, the semi-conductor layer formed on said substrate, and the semi-conductor layer of said substrate are formed is fixed to a leadframe for through a silver paste.
(41) Luminescence equipment given in (40) characterized by what the thickness of said reflecting layer is 100A – 1500A.
(42) Luminescence equipment given in (40) characterized by what the thickness of said reflecting layer is 150A – 1000A.

[Translation done.]

* NOTICES *

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TECHNICAL FIELD

[Industrial Application] This invention relates to an III group nitride system compound semiconductor light emitting device. It is related with the III group nitride system compound semiconductor light emitting device which equips with a reflecting layer a field opposite to the field in which the semi-conductor layer of a substrate is formed in detail.

[Translation done.]

PRIOR ART

[Description of the Prior Art] It has an III group nitride system compound semiconductor layer on insulating substrates, such as sapphire, and the light emitting device of a configuration of having formed the metallic reflective layer in the field opposite to the field in which the semi-conductor layer of a substrate is formed is indicated by JP,6-69546,A. It is enabled for a metallic reflective layer to reflect the light which emits light in the luminous layer formed into the semi-conductor layer, and comes out through a substrate, and to take it out from an electrode side, and it is prepared in order to raise the ejection effectiveness of the light of a light emitting device. In the above-mentioned official report, metaled simple substances or those alloys, such as aluminum, In, Cu, Ag, Pt, Ir, Pd, Rh, W, Mo, Ti, and nickel, are mentioned as an ingredient of a metallic reflective layer (this official report [0013]). Reference. .

[Translation done.]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] When this invention persons examined the metallic reflective layer formed in a field opposite to the field in which the semi-conductor layer of a substrate is formed, they found out the following technical problems. In the example given [above-mentioned] in an official report, the dicing saw has separated into the chip (0.5mmx0.5mm (example 1) or 1mmx1mm (example 2)), after forming a layer with a thickness of 3000A it is thin from aluminum as a reflecting layer and passing through an etching process etc. However, in separation of the chip using a dicing saw, a limitation is in a chip size separable on the engine performance of equipment. Then, if it is going to produce a minuter chip with the sufficient yield, a scribing line is put into a substrate with a scriber from an after [reflecting layer formation] reflecting layer side, and how to separate each chip along with this scribing line can be considered, for example. However, if aluminum etc. forms a reflecting layer with the metal of elasticity (hyperviscosity) and a low-melt point point comparatively like the above-mentioned example, in case the scribe of the reflecting layer will be carried out, the ingredient of a reflecting layer is a lifting and a cone about blinding with slag to the cutting edge of a scriber. It becomes impossible consequently, to perform a scribe process efficiently. Thus, it sees industrially and is not realistic to use the metal of elasticity, such as aluminum, and a low-melt point point as an ingredient of a reflecting layer.
[0004] Based on the above knowledge, this invention persons evaluated the fitness as a reflecting layer about some metals so that they may find out the ingredient of a suitable reflecting layer. The criteria of a reflection factor, corrosion resistance, and scribe nature (property in which a scribe can be performed convenient in the separation process of a chip) performed evaluation. In addition, it asked for corrosion resistance evaluation by corrosion resistance comprehensive evaluation to oxygen and chlorine. The evaluation result is shown below.
A metal A reflection factor Corrosion resistance The scribe nature Cr ** **-O **Ti ** **-O **aluminum O ** xAg O ** xRh O O OO: Whenever [high middle / of **:] x: This low result shows that it is the metal for which Rh was very suitable as a reflecting layer. In addition, if it carries out from a viewpoint of manufacture effectiveness, as long as the effectiveness as a reflecting layer is maintainable, it will be thought that it is desirable to make it thin as for a reflecting layer.
[0005] This invention is made as a result of the above-mentioned examination, and manufacture effectiveness aims at offering a high III group nitride system compound semiconductor light emitting device also with the high ejection effectiveness of light.

[Translation done.]

MEANS

[Means for Solving the Problem] This invention is made that the above-mentioned purpose should be attained, and the configuration is as follows. The III group nitride system compound semiconductor light emitting device which comes to prepare the reflecting layer which consists of Rh with a thickness of 50A - 2000A for a field opposite to the field in which a substrate, the semi-conductor layer formed on said substrate, and said semi-conductor layer of said substrate are formed.
[0007] Rh which is the ingredient of the reflecting layer of this invention can reflect the light which the reflection factor was high, arose in the luminous layer to the light, and passed the substrate in the direction of ejection of a main light at high rate. Moreover, since Rh is a hard (viscosity is low) and high-melting metal, when the scribe of the reflecting layer is carried out, it is hard to carry out blinding of the cutting edge of a scriber. Even if it is the case where heat arises by the scribe, it does not lifting-come to be easy of the blinding of the cutting edge of a scriber with the rise of viscosity. With the configuration of this invention, thickness of a reflecting layer is made into 50A - 2000A, according to the reflecting layer which has the thickness of this range, all can be reflected substantially [the light which passed the substrate and arrived at the reflecting layer front face], and the scribe of the reflecting layer in the separation process of a chip can be efficiently performed to coincidence. Thus, while being able to offer an III group nitride system compound semiconductor light emitting device with the high ejection effectiveness of light by taking the configuration which prepares the reflecting layer which consists of Rh of 50A - 2000A of thickness on a field opposite to the field in which the semi-conductor layer of a substrate is formed, the separation process of a chip can be performed efficiently and the rise of the manufacture effectiveness of a light emitting device is achieved.
[0008] Moreover, since Rh has corrosion resistance to oxygen, chlorine, etc., there is little degradation of a reflecting layer in a production process and a busy condition. Thus, by forming a reflecting layer by Rh, there is little degradation, and the reflecting layer by which quality was stabilized is obtained, namely, the light emitting device of high quality can be obtained.
[0009]
[Embodiment of the Invention] The semi-conductor layer of this invention consists of an III group nitride system compound semiconductor. An III group nitride system compound semiconductor is expressed with AlXGaYIn1-X-YN (0<=X<=1, 0<=Y<=1, 0 <=X+Y<=1) as a general formula, and includes the so-called 3 yuan system of the so-called 2 yuan system of AlN, GaN, and InN, AlxGa1-xN, AlxIn1-xN, and GaxIn1-xN (it sets above and is 0<=x<=1). Boron (B), a thallium (Tl), etc. may permute some III group elements, and Lynn (P), an arsenic (As), antimony (Sb), a bismuth (Bi), etc. can permute some nitrogen (N). An III group nitride system compound semiconductor may contain the dopant of arbitration. As for the component functional division of a light emitting device, it is desirable to constitute from an above-mentioned 2 yuan system or an III group nitride system compound semiconductor of a 3 yuan system. An III group nitride system compound semiconductor may contain the dopant of arbitration. Si, germanium, Se, Te, C, etc. can be used as an n mold impurity. As a p mold impurity, Mg, Zn, Be, calcium, Sr, Ba, etc. can be used. In addition, it is difficult to dope this p mold impurity and to use an III group nitride system compound semiconductor as the p type semiconductor of low resistance in a request, and after doping p mold impurity, it is desirable to expose an III group nitride system compound semiconductor to electron beam irradiation, a plasma exposure, or heating at a furnace. An III group nitride system compound semiconductor can be formed with the molecular-beam crystal growth method (MBE law) of common knowledge besides metal-organic chemical vapor deposition (MOCVD law), halide system vapor growth (HVPE law), a liquid phase grown method, etc.
[0010] The sapphire of translucency or ZnO is used for a substrate. It is because these ingredients are

transparent to the luminescent color. Especially the field into which the semi-conductor layer of an III group nitride system compound is grown up is not limited. The reflecting layer which consists of Rh is formed in the field (henceforth a "substrate rear face") where the III group nitride system compound semiconductor layer of a substrate is opposite to the field (henceforth a "substrate front face") by which a laminating is carried out. Since the light (henceforth "light of an opposite direction") which arose in respect of luminescence of a semi-conductor layer, and went in the direction of a substrate is reflected, a reflecting layer is prepared.

[0011] Rh is one of the platinum group metals, and the front face is silver white. Therefore, to a visible ray, a reflection factor can be high and the light of an opposite direction can be efficiently reflected on the front face. Moreover, to oxygen, chlorine, etc., since it is a stable metal, it is not corroded by washing in the production process of a light emitting device etc., and Rh also has little degradation by use of long duration. Furthermore, to Ag, since it is nonresponsiveness, it does not deteriorate by direct contact to the below-mentioned silver paste. In addition, since Rh is a hard metal, when a scribe is carried out in separation of a light emitting device, and a processing process, it is hard to block the cutting edge of a scriber. When heat arises by the scribe, even if it is, the melting point of Rh does not have a possibility of becoming it being easy to block the cutting edge of a scriber with 1970 degrees C since it is comparatively high, either.

[0012] Thickness of a reflecting layer is made into 50A - 2000A. It may be 50A or more for reflecting all by the reflecting layer substantially [the light of the opposite direction produced in respect of luminescence]. On the other hand, it is because it becomes the factor which reduces separation and processing effectiveness that considering as 2000A or less prepares a reflecting layer thick beyond the need since a part of reflecting layer is removed by the scriber in the separation process of the below-mentioned chip. Thickness of a reflecting layer is preferably made into 100A - 1500A. Furthermore, it may be 150A - 1000A preferably. although especially the formation approach of a reflecting layer is not limited -- CVD(s) (Chemical Vapour Deposition), such as plasma CVD, Heat CVD, and Light CVD, a spatter, vacuum evaporationo, the ECR method, etc. -- etc. (Pysical Vapour Deposition) etc. -- an approach can be used.

[Translation done.]

EXAMPLE

[Example] Hereafter, an example explains this invention in more detail. Drawing 1 is drawing showing the configuration of the light emitting device 10 which is the example of 1 of this invention. The spec. of each class is as follows.
Layer : Presentation: Dopant (thickness)
p type layer 15 : p-GaN:Mg (0.3 micrometers)
Luminous layer 14 : Superstructure Quantum well layer : $In_{0.15}Ga_{0.85}N$ (35A)
Barrier layer : GaN (35A)
The number of repeats of a quantum well and a barrier layer: 1-10n type layer 13 : n-GaN:Si (4 micrometers)
Buffer layer 12 : AlN (100A)
Substrate 11 : Sapphire (300 micrometers)
Reflecting layer 16 : Rh (300A)
[0014] a buffer layer 12 is used in order to grow up the semi-conductor layer of high quality -- having -- well-known MOCVD -- it is formed on substrate 11 front face of law etc. Although AlN was used as a buffer layer in this example it is limited to this -- ******** -- the duality of GaNInN -- a system and the III group nitride system compound semiconductor (ternary system) generally expressed with Al_xGa_yN ($0 \le x \le 1$, $0 \le y \le 1$, $x+y=1$) -- The III group nitride system compound semiconductor (4 yuan system) furthermore expressed with $Al_aGa_bIn_{1-a-b}N$ ($0 \le a \le 1$, $0 \le b \le 1$, $a+b \le 1$) can also be used. each semi-conductor layer -- well-known MOCVD -- it is formed of law. In this grown method, ammonia gas and the alkyl compound gas of an III group element, for example, trimethylgallium, (TMG), trimethylaluminum (TMA), and trimethylindium (TMI) are supplied on the substrate heated by suitable temperature, a pyrolysis reaction is carried out, it has, and a desired crystal is grown up on a buffer layer 12. of course, the thing by which the formation approach of each semi-conductor layer is limited to this -- it is not -- well-known MBE -- it can form also by law. As structure of a luminous layer, a luminous layer 14 may not be limited to the thing of a superstructure, but may be a terrorism mold and a gay assembling die in a terrorism mold and double to a single. In addition, a luminous layer can also be constituted using MIS junction and PIN junction.
[0015] The large $Al_XGa_YIn_{1-X-Y}N$ ($0 \le X \le 1$, $0 \le Y \le 1$, $X+Y \le 1$) layer of the band cap which doped acceptors, such as magnesium, can be made to intervene between a luminous layer 14 and p type layer 15. This is for preventing that the electron poured in into the luminous layer 14 is spread in p type layer 15. p type layer 15 can be made into the two-layer structure which consists of a low hole concentration p-layer by the side of a luminous layer 14, and a high hole concentration p+ side of the p electrode 18.
[0016] After the n electrode 19 consists of two-layer [of aluminum and V] and forms p type layer 15, it removes a part of p type layer 15, luminous layer 14, and n type layer 13 by etching, and is formed on n type layer 13 of vacuum evaporationo. The translucency electrode 17 is a thin film containing gold, it covers the substantial whole surface of the top face of p type layer 18, and a laminating is carried out. The p electrode 18 also consists of ingredients containing gold, and it is formed on the translucency electrode 17 of vacuum evaporationo.
[0017] After forming each semi-conductor layer and each electrode according to the above-mentioned process, the separation process of each chip and the formation process of a reflecting layer 16 are performed. First, Rhine with a depth of about 10 micrometers is put into the boundary of each chip of the field where the laminating of each semi-conductor layer was carried out by dicing. Then, a substrate 11 is made into the thickness of 3 about 1/by grinding a substrate rear face. Next, after carrying out organic washing of the ground substrate rear face, a reflecting layer 16 is formed on a substrate rear

face by carrying out 300A laminating of the Rh with EB vacuum deposition. Then, from a reflecting layer 16 side, the scribe of the boundary of each chip is carried out, and a scribing line is put into the boundary of each chip on the rear face of a substrate. Finally, a braking process is performed and each chip is separated. A 320micrometerx320micrometer chip is obtained according to the above-mentioned process.

[0018] After separating into each chip, a reflecting layer 16 is fixed to the metal leadframe 30 through the silver paste 40, and the p electrode 18 and the n electrode 19 are connected to leadframes 30 and 31 by wires 32 and 33, respectively. Then, it considers as a luminescence equipment lamp (refer to drawing 2) by carrying out the closure by closure resin 50. When the luminous intensity of the luminescence lamp 20 was measured, as compared with elegance, one about 1.5 times the luminous intensity of this was obtained conventionally which does not form a reflecting layer 16.

[0019]

[Test Example(s)] Next, the luminous-intensity decreasing rate by time amount progress of the light emitting device 10 of an example was evaluated. It asked for the ratio of the luminous intensity of the luminescence lamp 20 and initial luminous intensity in each measuring time at the time of supplying a 30mA current continuously as relative luminous intensity under 100-degree C temperature conditions using the luminescence lamp 20 which included the light emitting device 10 in the trial, and the luminous-intensity decreasing rate by time amount progress was evaluated by measuring the relative luminous intensity of each measuring time. As an example of a comparison, a reflecting layer 16 was not formed in the light emitting device 10, but what made other configurations the same as that of the luminescence lamp 20 was used. A test result is shown below.

Initial value 100 hours after 1000-hour late-coming light lamp 20 (Rh reflecting layer) 100 95 Example of 92 comparisons (with no reflecting layer) 100 80 From the 60 above-mentioned test result, although luminous intensity falls about 40% by continuation lighting of 1000 hours in the example of a comparison, luminous intensity falls only about 8% with the luminescence equipment 20 which prepared the reflecting layer which consists of Rh. From this result, by preparing the reflecting layer which consists of Rh shows that the luminous-intensity fall by use of long duration is controlled sharply.

[0020] As mentioned above, the light emitting device of this invention has the advantage that manufacture effectiveness is good, highly [the ejection effectiveness of light] by preparing the reflecting layer of the predetermined thickness it is thin from Rh. Furthermore, since a reflecting layer is formed with a corrosion resistance ingredient, it has the luminous-intensity fall by prolonged use, and the advantage of being very few.

[0021] This invention is not limited to explanation of the gestalt of implementation of the above-mentioned invention, and an example at all. It does not deviate from the publication of a claim but deformation modes various in the range this contractor can hit on an idea of easily are also contained in this invention.

[0022] Hereafter, the following matter is indicated.

(10) The layered product which comes to prepare the reflecting layer which consists of Rh with a thickness of 50A - 2000A for a field opposite to the field in which a substrate, the semi-conductor layer formed on said substrate, and the semi-conductor layer of said substrate are formed.

(11) A layered product given in (10) characterized by what the thickness of said reflecting layer is 100A - 1500A.

(12) A layered product given in (10) characterized by what the thickness of said reflecting layer is 150A - 1000A.

(20) The manufacture approach of the III group nitride system compound semiconductor light emitting device which comes to contain the step which forms 50A - 2000A of reflecting layers which consist of Rh on the field of other 1 in which the step which forms an III group nitride system compound semiconductor layer on the field of 1 of a substrate, and said semi-conductor layer of said substrate are not formed.

(21) The thickness of said reflecting layer is the manufacture approach of an III group nitride system compound semiconductor light emitting device given in (20) characterized by what is been 100A - 1500A.

(22) The thickness of said reflecting layer is the manufacture approach of an III group nitride system compound semiconductor light emitting device given in (20) characterized by what is been 150A - 1000A.

(23) (20) characterized by what said substrate is separated for by carrying out a scribe from said reflecting layer side thru/or the manufacture approach of an III group nitride system compound

semiconductor light emitting device given in (22).
(30) The III group nitride system compound semiconductor light emitting device manufactured by the production process which comes to contain the step which forms 50A - 2000A of reflecting layers which consist of Rh in other fields of 1 in which the step which forms an III group nitride system compound semiconductor layer in the field of 1 of a substrate, and said semi-conductor layer of said substrate are not formed.
(31) The III group nitride system compound semiconductor light emitting device manufactured by the production process which comes to contain the step which forms 50A - 2000A of reflecting layers which consist of Rh in other fields of 1 in which the step which forms an III group nitride system compound semiconductor layer in the field of 1 of a substrate, and said semi-conductor layer of said substrate are not formed, and the step which separates said substrate by carrying out a scribe from said reflecting layer side.
(32) The thickness which forms said reflecting layer is an III group nitride system compound semiconductor light emitting device given in (30) characterized by what is been 100A - 1500A, or (31)
(33). The thickness which forms said reflecting layer is the manufacture approach of an III group nitride system compound semiconductor light emitting device given in (30) characterized by what is been 150A - 1000A, or (31).
(40) Luminescence equipment characterized by what the III group nitride system compound semiconductor light emitting device which comes to prepare the reflecting layer which consists of Rh with a thickness of 50A - 2000A for a field opposite to the field in which a substrate, the semi-conductor layer formed on said substrate, and the semi-conductor layer of said substrate are formed is fixed to a leadframe for through a silver paste.
(41) Luminescence equipment given in (40) characterized by what the thickness of said reflecting layer is 100A - 1500A.
(42) Luminescence equipment given in (40) characterized by what the thickness of said reflecting layer is 150A - 1000A.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the configuration of the light emitting device 10 which is the example of this invention.
[Drawing 2] It is drawing showing the configuration of the luminescence lamp 20 which similarly incorporated the light emitting device 10.
[Description of Notations]
10 Light Emitting Device
11 Silicon on Sapphire
12 Buffer Layer
13 N-GaN Layer
14 Luminous Layer
15 P-GaN Layer
16 Reflecting Layer
20 Luminescence Lamp
40 Silver Paste

[Translation done.]